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BUREAU OF STANDARDS

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TYPE TESTING OF FREQUENCY-CHECKING APPARATUS FOR BROADCAST STATIONS

At the request of the Federal Radio Commission the bureau has begun the testing of several types of special frequency-checking equipment now offered by various manufacturers to broadcast stations. These equipments are intended to fulfill the requirements specified in the Commission's Regulation No. 145. Briefly, the regulation requires every broadcast station, on and after June 22 this year, to maintain its frequency within plus or minus 50 cycles of the assigned frequency and to have some form of visual indicating instrument entirely independent of the frequency-control equipment, to indicate the departure of the station frequency from the assigned frequency. From the results of the tests as reported by the bureau to the commission, approval or disapproval of the frequency checking equipment will be determined by the commission.

The manufacturers of such equipment, after making arrangements for test with the commission, forward the sample equipment, adjusted for use at 1,500 kilocycles, to the Bureau of Standards for test. The approval of a particular type of equipment will be announced to the broadcast stations by the Federal Radio Commission; the individual frequency-checking equipment of that type will not have to be tested by the bureau.

The frequency-checking equipments thus far offered consist of a temperature-controlled piezo oscillator of great accuracy and stability having either the frequency of the broadcast station or else differing from it by 500 or 1,000 cycles, and suitable systems for bringing the frequency of the transmitter and piezo oscillator together, rectifying and amplifying the frequency difference and impressing it upon a direct-reading frequency meter with a scale reading from 0 up to 50 or 100 cycles in both directions. Some of these equipments are made to operate entirely from alternating current supply, while others use alternating current only for the heating units.

The tests, 14 in number, made by the bureau on each equipment, require about five weeks to complete. Some of the 14 tests are made twelve times during the month. The tests include such items as accuracy, sensitivity, temperature control stability, and such miscellaneous tests as the effects of changing tubes, varying voltages, etc. Tests at room temperatures of 15°, 25°, and 35° C. are included. The tests are intended to show what performance may be expected from the equipment in actual use in a broadcast station.

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The Bureau of Standards makes tests of frequency standards for transmitting stations of any frequency only upon request of the Federal Radio Commission.

RADIO TRANSMISSION OVER LONG PATHS

During the radio operations of the Byrd Antarctic Expedition it was found necessary to establish a station at Dunedin, New Zealand, for purposes of communication and for observations of radio transmission phenomena. This station was located in an exceptionally fine situation at about 500 feet altitude overlooking the Pacific Ocean.

Regular measurements of the signal strengths of a number of American and European short-wave stations were made by means of apparatus prepared at the Bureau of Standards. These measurements extended over a period of several months. The results of this work will be published in the February number of the Bureau of Standards Journal of Research.

Certain observations show that high-frequency signals traveling along paths of prolonged darkness do not remain constant after the path becomes wholly dark, but are subject to a loss, which is greater with the higher frequencies and increases as the darkness is prolonged.

Though signals over long paths are shown generally to increase as the proportion of darkness to daylight along the path is increased, this is not necessarily always the case. Under certain conditions the absorption in the portion of the Kennelly-Heaviside layer under direct radiation of the sun is shown to increase more rapidly than the decrease in absorption due to the gradual approach of darkness along the path.

Among the most interesting of the observations is a violent fading of signals from England shortly before sunrise. A study of this fading indicates that at this time the signal apparently does not follow the great circle path along the earth but appears to come along a path approximately 15° from the great circle path.

During the second voyage of the *City of New York* to the Antarctic, and while in the vicinity of the south magnetic pole, a major magnetic storm occurred. During this time signals faded to a small fraction of their normal value, in most cases disappearing entirely, while at the same time WFA at Little America continued its communications, noting only a small diminution in signal strength. This indicates that the effect was largely localized.

DISTANCE RANGES OF RADIO WAVES

It is well known that the distances over which practical radio communication is possible vary greatly with the frequency used and with many other factors. The effects of some of these factors can not be predicted. Nevertheless sufficient experience has accumulated so that the distance ranges under average conditions can be fairly well summarized. Such a summary is a valuable guide in radio operations, and is given in a letter circular just prepared by the bureau.

The information is given mainly in two graph sheets, one for day and one for night transmission. The whole range of radio frequencies is covered. The effects of wave transmission along the ground and in the upper atmosphere is explained. A brief bibliography is included.

Any one having use for the information can secure a copy upon request for Letter Circular 317, Distance Ranges of Radio Waves, addressed to Bureau of Standards, Washington, D. C.

SECULAR CHANGE IN PRECISION-BALANCE BEAM

Recently the bureau's 25-kg precision balance was completely overhauled. After finishing this work, data on the relative length of the two arms of the beam were gathered and plotted to show the continuous change that has been taking place over a period of more than 20 years.

During the last few years the change appears to have been somewhat less rapid than it was at first, but it has been remarkably uniform and continuous, there having been no conspicuous break except at a time when the knife-edges were reground slightly in order to straighten the edges. From 1911 to 1930 the inequality changed from 16 parts per million to 72 parts per million. This change is in relative length of the two arms, and gives no indication of the total change in length. In fact, it might be caused by warping, without any great change in actual length. Therefore, it may be an entirely different process from the changes in length sometimes noted in length standards.

RUBBER DIAPHRAGMS FOR AERONAUTIC INSTRUMENTS

It is recognized that rubber with good aging characteristics would be of value as a material for making diaphragms for sensitive pressure indicators, owing to its large deflections as compared with other materials commonly used. Rubber diaphragms used previous to 1924 performed satisfactorily for a short period of time, but owing to the rapidity with which the rubber deteriorated the instruments required frequent recalibrations and ultimately became unfit for use in a much shorter time than is desirable.

In cooperation with the National Advisory Committee for Aeronautics, an investigation was carried out at the bureau on special compositions of rubber suitable for use as diaphragms for aircraft instruments. As part of this study six samples of rubber were used as taut diaphragms in instruments and allowed to age for five years. Two of the instruments were in operating condition after this period of time, and one showed remarkably little change in performance.

It should be remarked that when this investigation was undertaken in 1924, none of the commercial antioxidants now used in rubber were available.

FORMATION OF GUM IN GASOLINE

Gasolines are frequently stored over periods ranging from six months to two years, and if the gasoline is to be satisfactory as a motor fuel at the end of that period, its gum content must not have become greater than the permissible value for satisfactory engine performance. Obviously it is important to be able to predict in advance how much gum will be present at the end of the storage period, and the bureau is endeavoring to develop a test method which will give this information.

The formation of gum is related to the amount of oxygen from the air which combines with the gasoline. In storage, this combination of the oxygen with the gasoline takes place very slowly over a period of months, but if the gasoline is heated under pressure at the boiling point of water, the combination with oxygen takes place in a few hours. In the investigation now in progress, tests are being made at these elevated temperatures in the hope that a relation may be found between the gum formation at the higher temperature and the gum formation in storage. While the results obtained to date have not completely solved the problem, the method used appears very promising.

PROPERTIES OF FIBER BUILDING BOARDS

Copies of Bureau of Standards Miscellaneous Publication No. 132 of the above title can now be obtained from the Superintendent of Documents, Washington, D. C. (Price, 5 cents each.)

Wall boards and insulating boards, the two principal classes of fiber building boards, have been studied at the bureau to obtain information relative to the properties of these important building materials.

Tests were made on 15 samples of wall boards and 8 samples of insulating boards, representative of the commercial products in common usage. Weight, thickness, density, strength, absorption of moisture, and changes in dimension with changes in moisture content were studied. Special apparatus was developed for determining the strength and for indicating changes in dimension with changes in moisture content. Some discussion of heat insulation, air infiltration, and susceptibility to molds is included.

There was no marked difference in the strength of the different boards studied. The average thickness of wall boards was less than that of insulating boards, but the density of the wall boards was greater and the strength was approximately the same for both classes. There were no marked differences as regards absorption of moisture or changes in dimension with changes in moisture content, except that the crosswise expansion of the laminated or built-up boards was greater than that of homogeneous or 1-piece boards. The difference in thermal conductivity between the various insulating boards has been found by previous work at the bureau to be small, and the average wall boards are so thin and of such density as to be considered of relatively much smaller value as heat insulators.

The results of laboratory tests of the various boards are tabulated, the test methods used are described, and the different properties considered important are discussed in detail.

HYGROMETRY IN PAPER TESTING

The following is an abstract of a paper by F. T. Carson and F. V. Worthington of the Bureau of Standards, presented at the sectional meeting on paper testing in connection with the

annual meeting of the Technical Association of the Pulp and Paper Industry in New York on February 16.

Many of the properties of paper are governed to a considerable extent by the amount of moisture which the paper contains, this moisture content in turn being determined by the hygrometric state of the surrounding atmosphere. Since this hygroscopic moisture, being in the condensed state, acts much like liquid water, it follows that a constant relative vapor pressure in the atmosphere, rather than a constant absolute vapor pressure, is the condition primarily necessary in maintaining a constant moisture content in paper under laboratory conditions.

Based largely on the literature of hygrometry and of paper testing, an attempt has been made at a logical estimate of the requirements in humidity measurement in the paper testing laboratory. Hygrometric methods were briefly discussed with an appraisal of their suitability for the purpose. The analytical methods, usually regarded as the ultimate standards of reference, are tedious, and insufficiently rapid for routine measurement. The dew-point method is simple in theory and is apparently capable of considerable accuracy, but it has several practical limitations. Filament hygrometers, although unreliable as standards, are very useful in the laboratory as simple means of indicating and recording fluctuations in hygrometric conditions. The ventilated wet and dry bulb psychrometer, if properly designed and used, is apparently the most suitable means of measuring the hygrometric state in the laboratory. Psychrometric conversion data are an essential part of this method. Since it is necessary to read the wet-bulb and dry-bulb thermometers to the nearest tenth of a degree centigrade in the testing laboratory a psychrometric chart has been prepared compatible with this degree of sensitivity which is found convenient for converting the psychrometric data to relative humidity.

SOME HIGH COMPRESSIVE STRENGTHS FOR STONE

Recent tests on samples of quartzite submitted by the United States engineers office from the State of Montana gave such unusually high compressive strengths that some curiosity was aroused as to what type of rock really stands highest in this respect. An examination of the test records of this bureau showed the following extreme values for compressive strength:

	Lbs./in.²
Quartzite from Montana	63,000
Marble from Vermont	50,000
Novaculite from Arkansas	44,000
Granite from Maryland	42,000
Limestone from Tennessee	40,000
Sandstone from Wisconsin	29,000

Even the highest of these is somewhat lower than a test made some time ago in Germany on basalt which gave 67,000 lbs./in.². Such high strengths can be better appreciated by computing the height of a self-sustaining wall of the materials. For example, the quartzite having a weight of 165 pounds per cubic foot would have to be built up over 10 miles high before failure would occur from crushing.

In general, it may be said that the values given above are from two to four times the average strength of the various types named, except for novaculite which is probably not far from the average.

RESISTANCE TO ABRASION OF A SILLIMANITE PORCELAIN DIE WHEN USED FOR EXTRUDING CLAY COLUMNS

A concern manufacturing spark-plug porcelain has equipped its extrusion machines with "sillimanite" porcelain dies for extruding "spark-plug blanks." The batch composition of the porcelain consists very largely of andalusite, which has a hardness of 7.5 (Moh's scale), or 0.5 greater than the hardness of quartz.

Twelve tests were made on each of duplicate specimens of porcelain dies furnished by the manufacturer. Although tests on the duplicate specimens checked very closely, successive tests showed increasing abrasion losses. The hard "skin" which occurs on well-vitrified porcelain is similar to that on glass and inasmuch as the tests showed that this hard skin decreased in service value with depth as abrasion progressed, the service values $C_{\frac{1}{2}}$ were determined for each of the 12 duplicate tests. These were determined from the equation $C_{\frac{1}{2}} = X_{\frac{1}{2}} \div Y$, in which "$n$"=0.645, "$X$"=extrusion pressure, and "Y"=abrasion loss. The service values varied from 107.17 at the end of the first test to 66.25 at the end of the twelfth. At the end of the twelfth test the depth of the material removed was 0.1164 mm, or approximately 0.004584 of an inch.

The service values when plotted against depth gave a hyperbolic curve

which is expressed by the equation: $(U-A)(V+B)=K$, in which "U" is service value, "V"=depth in mm, "A"=45.78, "B"=0.04622, and "K"=3.235.

At the surface (when "V"=0), the service value as determined by calculation is 115.76. Whether the relation between depth and service value continues according to this hyperbolic equation beyond the experimental limits is not known. If, however, it is assumed that the relation does continue even to an infinite depth, the service value of the porcelain can not fall below the value of "A," which is 45.78.

TENSILE PROPERTIES OF RAIL STEELS AT ELEVATED TEMPERATURES

It is believed by many that shatter cracks, which are usually found in the heads of rails failing from transverse fissures, are caused by stresses, set up while the rail is on the cooling bed, which, in turn, are caused by temperature gradients in the rail sections; also that shatter cracks serve as nuclei from which transverse fissures subsequently develop in service.

Elevated temperature tensile tests have shown that rail steels are markedly brittle in the neighborhood of 550° C., which is known as the secondary brittle range. It is thought that shatter cracks form in some rails when they cool in the ordinary way through this range of low ductility.

Tests reported in the February number of the Bureau of Standards Journal of Research show that slower cooling from the hot saw increases the ductility in the secondary brittle range but decreases it somewhat at about 400° C., so that the ductility curves for the slowly cooled rails fluctuate less than those for normally cooled rails.

There was no difference in the tensile properties of fissured and unfissured rails that had been subjected to the same service. Tests were also made on rails from a mill whose product had a poor service record and on rails from the same mill made subsequently when the product was yielding better service records. Although the ductility of all of these rails did not show a sharp inversion in the secondary brittle range, the values were low at elevated temperatures. Shatter cracks were found in all of the rails that failed in service from transverse fissures, whereas no cracks were found in rails that had been subjected to the same service without failures. Tests on a medium manganese rail deoxidized with zirconium showed this rail also to have marked secondary brittleness.

DETERMINATION OF SMALL AMOUNTS OF TIN

Apparently tin is invariably a constituent of irons and steels, usually in amounts ranging from a few thousandths to a few hundredths of 1 per cent. Accurate determinations of these small amounts of tin are very desirable in connection with researches on the properties of irons and steels. Methods in use at the present time are unsatisfactory and the reliability obtained has not been carefully studied. As a result of work recently completed at the bureau, a method has been developed by which determinations accurate to 0.001 per cent can be easily obtained. This is an iodometric method in which the tin has first been quantitatively recovered and separated from interfering elements such as chromium, vanadium, molybdenum, and tungsten, by means of a preliminary precipitation with hydrogen sulphide in nitric acid solution, followed by a second precipitation with ammonium hydroxide in the presence of a little added ferric chloride.

The complete description of this work will be found in the February number of the Bureau of Standards Journal of Research.

NEW CIRCULAR ON ZINC

Although zinc has been used for generations and in the form of the alloy, brass, dates back to antiquity, it is in many respects a modern metal. Not until within the past decade has the metal been systematically studied and its properties carefully determined. Circular No. 395 of the Bureau of Standards which has just been issued, is devoted to this metal and its alloys. It contains a wealth of information on zinc, summarized from the technical literature and supplemented by the results of tests carried out at the bureau. This publication follows the general lines of others on the properties of metals and alloys which have been issued by the bureau and which include circulars on copper, nickel, aluminum, and bismuth.

Zinc is now available commercially in a state of very high purity. Recent improvements in both the smelting process and the electrolytic process have made available metal with a zinc content close to 99.99 per cent. Zinc of very high purity has been found to

be extremely resistant to corrosion by most of the common acids.

On account of the relative ease with which zinc can be produced in large crystals, a great deal of study has been devoted to the properties of the metal in the form of single crystals and much light has been thrown on the subject of its plastic deformation.

Zinc crystallizes in the hexagonal system, and the basal hexagonal planes; that is, the planes perpendicular to the principal crystalline axis are the ones upon which deformation by slip readily occurs. A crystal stressed so that slip on basal planes can readily occur shows extremely high ductility. The same crystal when stressed in other ways will show practically no ductility.

Recent studies carried out on the extremely pure zinc now available have not supported the statements previously made by other investigators concerning the allotropy of zinc. Zinc, evidently, exists in only one crystalline form.

Although sheet zinc possesses very good tensile strength, it is not in the same class with sheet steel or iron. Zinc is much more ductile, and when maintained for long periods of time under sustained loading, it may "creep" or sag. This property of zinc must be borne in mind if it is to be used to best advantage in roofing and for other building purposes. The ordinary rules of construction have been developed for other materials and should not be applied indiscriminately to any and all materials of construction.

By far the greatest outlet for zinc is in galvanizing. In this country nearly half of the zinc produced annually is used for this purpose. Zinc coating by galvanizing—that is, dipping in molten zinc—is possible because of the ready alloying which occurs between liquid zinc and iron. This makes it possible for the metal to "wet" the iron surface, a circumstance not possible with some metals; for example, lead.

Of the alloys of zinc, brass is by far the most important. The properties of brass are closer to those of copper than of zinc since zinc is the minor constituent. Of the zinc-rich alloys, those used for die-casting purposes are the most important. The alloys which are most used in this country are those of zinc, copper, and aluminum; the zinc constituting over 90 per cent of the whole. Great advances have been made in the die-casting art and in the preparation of the die-casting alloys. These materials are widely used and may be regarded as entirely reliable for the uses for which they are developed.

The circular contains many half tones, graphs, and tables which add greatly to its value for reference purposes. Copies may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C., at 70 cents apiece.

QUARTERLY MEETING OF FEDERAL FIRE COUNCIL

The regular meeting of the Federal Fire Council was held at the new Commerce Building on January 29 and was attended by 28 representatives of governmental departments and establishments. A. G. Thomas, vice chairman, who presided, indicated that the council was entering into the second phase of its work to judge from the report of the committee on inspection and interdepartmental cooperation. The function of this committee is to make direct contact with the departments and establishments on matters pertaining to fire prevention and protection and assist them in attaining the desired degree of fire safety.

The fire-hazards committee presented no report of surveys of buildings in Washington, but referred to two reports on surveys conducted by the field-service department of the National Fire Protection Association, namely, that on the Leavenworth Penitentiary and on the prison camp at Fort Eustis, Va. These reports had been circulated to the membership a short time in advance of the meeting and were accepted with appreciation for the large amount of work they represent and the able way in which the fire hazards and protection measures were analyzed and outlined. The Leavenworth Penitentiary houses about 3,200 prisoners, and while the buildings are generally of fire-resistive construction some decided fire hazards were found; for example, in the factories, the auditorium, and the hospital. The site and buildings of the prison camp at Fort Eustis have been transferred from the War Department to the Bureau of Prisons, and the camp is being organized to care for approximately 600 inmates. The buildings are of nonfire-resistive construction, but are generally not over two stories in height. Reference was made to a request for a fire survey of the properties of the National Park Service of the Department of the Interior. This service controls hotels and other buildings of aggregate value of approximately $10,000,000.

The committee on apparatus and appliances presented an initial report on recommendations for given types of fire alarm and watchman's supervisory equipment for a given size or cost of building, the recommendations being limited in the present report to individual buildings built for the Post Office Department. The committee expects to continue its work on this project so as to include buildings and groups of buildings representative of the range incidental to Government occupancy.

The committee on inspection and interdepartmental cooperation presented for tentative adoption a self-inspection report form to be distributed to the departments and establishments. The surveys reported on the form are intended to be made at intervals not exceeding one month and are reported to the officials in responsible charge of the building or group of buildings concerned. The fire hazards and needed protection measures are indicated by questions and explanatory notes, and the object throughout is to make the import so clear that the inspection can be made without previous experience.

The committee on fire record presented a recommended form for the reporting of fires which was adopted for initial distribution, such reports to begin as of January 1, 1932.

George S. Watson, chief engineer of the District of Columbia Fire Department, presented a paper that had been prepared with the assistance of battalion chief, Edward L. Pierce, on the functions and organization of his department. The fire department has a personnel of about 900 and has a total of 37 fire stations valued in land and equipment at about $3,000,000, the annual expenditures being about $2,000,000. The fire-fighting division, which includes over 90 per cent of the personnel, is divided into seven sections, each in charge of two battalion chiefs, one for day and one for night. The department is organized on the 2-platoon system, each shift serving 12 hours, with weekly alternation of day and night duties The method of response and details of procedure in case of single or multiple alarm fires are described in detail.

Increasing emphasis is being placed on fire prevention which functions under a fire marshal with 17 deputies and inspectors. The three general lines of endeavor are: (1) The elimination of so-called housekeeping conditions conducive to the start or spread of fire, (2) the provision of adequate emergency exit facilities for occupants in case of fire, and (3) the control of fire by means of privately maintained extinguishing mediums. Attention was particularly called to the activity of this division in the detection and punishment of arson, which crime had been thought until recently to be nonexistent in the District of Columbia.

The fire department maintains an instruction division under a battalion chief in which instruction is given to all new members of the department in groups of 20. The division has a 65-foot drill tower with a supply of all of the equipment used by the fireman in his work. The administrative division has charge of personnel and property records, including recruiting of personnel and erection and equipment of new buildings. The fire department maintains its own repair division equipped to handle a great variety of repair and maintenance items, from remodelling of pumping engines to testing and repair of hose, of which latter about 186,000 feet are in service. A summary enumerating in detail the equipment carried by each company and costs of same is appended.

The paper will, without doubt, prove of great value to those charged with the organization or maintenance of fire-fighting units. The District of Columbia has a low fire loss as compared with cities of its class, the average loss per capita for the past 21 years being $1.83 against a general average for other cities of about $3 per capita. While the number of fire alarms has increased from year to year until in 1931 a total of 6,337 alarms were responded to, the cost per fire has steadily declined indicating the increasing efficiency of the fire department's work.

NEW AND REVISED PUBLICATIONS ISSUED DURING JANUARY, 1932

Journal of Research[1]

Bureau of Standards Journal of Research, vol. 8, No. 1, January, 1932 (RP Nos. 396 to 406, inclusive). Price, 40 cents. Obtainable by subscription.

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[1] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C.

Subscription to Technical News Bulletin, 25 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 40 cents. Subscription to Journal of Research, $3 per year; other countries, $3.75. Subscription to Commercial Standards Monthly, $1 per year; other countries, $1.25.

Research Papers [1]

(Reprints from Journal)

RP367. An improved audio-frequency generator; E. G. Lapham. Price, 10 cents.

RP374. The relative spectral energy distribution and correlated color temperature of the N. P. L. white-light standard; R. Davis and K. S. Gibson. Price, 5 cents.

RP375. Isolation and determination of methylcyclopentane in a midcontinent petroleum; M. M. Hicks-Bruun and J. H. Bruun. Price, 5 cents.

RP376. The photographic emulsion; the silver ion gelatin equilibrium; B. H. Carroll and D. Hubbard. Price, 5 cents.

RP377. A general formula for the computation of colorimetric purity; D. B. Judd. Price, 5 cents.

RP378. Variation of photographic sensitivity with different light sources; R. Davis and G. K. Neeland. Price, 5 cents.

RP380. The use of zinc oxide in determinations of cobalt and manganese; J. I. Hoffman. Price, 5 cents.

RP381. The decomposition of tricalcium silicate in the temperature range, 1,000° to 1,300° C.; E. T. Carlson. Price, 5 cents.

RP383. Isolation of normal nonane from a mid-continent petroleum; J. D. White and F. W. Rose, jr. Price, 5 cents.

RP384. The analysis of cyanide silver-plating solutions; R. M. Wick. Price, 10 cents.

RP385. Silvering and evacuating Pyrex Dewar flasks; R. B. Scott, J. W. Cook, and F. G. Brickwedde. Price, 5 cents.

Circulars [1]

C395. Zinc and its alloys. Price, 70 cents.

C396 (Supersedes C380). Architectural acoustics; P. R. Heyl. Price, 5 cents.

Simplified Practice Recommendations [1]

R17-31. (3d ed.) Forged tools. Price 15 cents.

Commercial Standards [1]

CS31-31. Red cedar shingles. Price, 10 cents.

CS35-31. Plywood (Hardwood and Eastern Red Cedar). Price, 10 cents.

Commercial Standards Monthly [1]

Commercial Standards Monthly, vol 8, No. 7, January, 1932. Price 10 cents. Obtainable by subscription.

Technical News Bulletin [1]

Technical News Bulletin No. 177, January, 1932. Price, 5 cents. Obtainable by subscription.

LETTER CIRCULARS [2]

LC315. Railroad track scale testing service of the National Bureau of Standards, fiscal year July 1, 1930, to June 30, 1931.

LC316. Publications of the engineering mechanics section of the Bureau of Standards. (Mimeographed list.)

LC317. Distance ranges of radio waves.

LC318. Committee on reconditioning, remodeling, and modernizing (of houses).

OUTSIDE PUBLICATIONS [3]

Thermal expansion of electrolytic chromium. P. Hidnert; Physical Review (Corning, N. Y.), vol. 39, p. 186; January, 1932.

Is mercury poisonous in dental amalgam restorations? Wilmer Souder and W. T. Sweeney; Dental Cosmos (Philadelphia, Pa.), vol. 73, No. 12, p. 1145; December, 1931.

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[1] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C.

Subscription to Technical News Bulletin, 25 cents per year (United States and its possessions, Canada, Cuba, Mexico, Newfoundland, and Republic of Panama); other countries, 40 cents. Subscription to Journal of Research, $3 per year; other countries, $3.75. Subscription to Commercial Standards Monthly, $1 per year; other countries, $1.25.

[2] "Letter circulars" are in mimeographed form and are designed primarily to answer specific inquiries. The supply is necessarily limited, so that, in general, but one copy can be sent in answer to each request. Copies are available only on application to the Bureau of Standards, Washington, D. C. No mailing list is maintained for "letter circulars," and complete sets of back numbers can not be furnished.

[3] "Outside publications" are not for distribution or sale by the Government unless otherwise noted. Requests should be sent direct to publishers.

Gasoline vapor pressures permissible with 1931 motor cars. O. C. Bridgeman, H. S. White, and F. B. Gray; Proceedings, Twelfth Annual Meeting, American Petroleum Institute (New York, N. Y.), Section III, p. 40; December, 1931.

Detonation characteristics of motor fuels. N. R. White and H. K. Cummings; Bureau of Mines (Washington, D. C.). Twenty-third semiannual motor-gasoline survey—Part III, R. I. 3152, p. 12; November, 1931. (Obtainable only on application to the Bureau of Mines.)

Ultraviolet transmitting glasses. W. W. Coblentz; Journal, American Medical Association (Chicago, Ill.), vol. 95, p. 864; September 20, 1930; revised to November, 1931.

Sources of radiation and their physical characteristics. W. W. Coblentz. Journal, American Medical Association (Chicago, Ill.), vol. 97, p. 1965; December 26, 1931.

Electricity from the sun. W. W. Coblentz; Popular Mechanics Magazine (Chicago, Ill.), vol. 57, No. 3, p. 418; March, 1932.

Use of glycol-phthalic anhydride resin as a high-vacuum cement. T. P. Sager and R. G. Kennedy, jr.; Physics (Menasha, Wis.), vol. 1, No. 6, p. 352; December, 1931.

The status of chromium plating. W. Blum; Journal, Franklin Institute (Philadelphia, Pa.), vol. 213, p. 17; January, 1932.

The National Hydraulic Laboratory at the Bureau of Standards. H. N. Eaton; Transactions, American Geophysical Union (Washington, D. C.), Section on Hydrology, p. 216, May 1, 1931.

Hygrometry in paper testing. F. T. Carson and F. V. Worthington; Paper Trade Journal (New York, N. Y.), January 14, 1932.

Determination of oxygen, nitrogen, and hydrogen in steel. J. G. Thompson; American Institute of Mining and Metallurgical Engineers (New York, N. Y.), Technical Publication No. 466, January, 1932.

Bonding magnesite linings for steelmaking furnaces with use of iron oxide. Louis Jordan; Metals and Alloys (Chemical Catalog Co., New York, N. Y.), vol. 3, p. 22; January, 1932.

Cyanides in metallurgy. M. R. Thompson; Transactions, Electrochemical Society (New York, N. Y.), vol. 60, p. 35; 1931.

The decomposition of tricalcium silicate in the temperature range 1,000° 1,300° C. E. T. Carlson; Rock Products (Chicago, Ill.), vol. 34, No. 25, p. 52; December 5, 1931.

Progress report on investigation of sagger clays. VI. R. A. Heindl and L. E. Mong; Journal, American Ceramic Society (Columbus, Ohio), vol. 14, No. 12, p. 867; December, 1931.

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